

Representation of STEM Professions in Children's Picture Books

Gamze BİLİR-SEYHAN

Ege University

gamze.bilir.seyhan@ege.edu.tr

Fulden GÜLER-NALBANTOĞLU

Ege University

fulden.guler@ege.edu.tr

Abstract

The characteristics of early-age children, such as curiosity, creativity, and collaboration, align with the essential attributes of STEM education. Consequently, it is important to examine the perspectives of children's picture books regarding STEM professions (gender, field of study, inferred action, etc.). Children's picture books tailored for this purpose should be designed in a simple way in terms of form and content, written in an understandable language, and supported by visuals. In this way, opportunities will be provided for children to learn various concepts, events, and situations more easily through books. In this study, the representation of STEM professions in children's picture books during early childhood was examined. The study utilized document analysis, and the study group consisted of STEM-themed books available from publishing houses specializing in illustrated children's literature in Turkey. After forming the keywords and searching relevant publishing houses, ten books were included in the data analysis. The books were analyzed using the book review form developed by the researchers. The main findings of the study revealed that female characters were prominent in STEM professions in these books. Furthermore, the majority of the characters in STEM-themed picture books depicted engaging in product design and invention when examining the inferred actions. Additionally, objects such as writing tools, construction tools, and fictional machines were widely used by the characters in STEM-themed picture books. The representation of STEM professions in these picture books offers children inspiring role models, showcasing potential success and providing impactful narratives. Consequently, books emerge as effective tools in aiding children's understanding of specific concepts during their early years.

[This paper was published in: "EJER Congress 2023 International Eurasian Educational Research Congress Conference Proceedings," Ani Publishing, 2023, pp. 163-178]

Keywords: *Early childhood, child literature, STEM education, picture books*

Introduction

STEM education, which stands for Science, Technology, Engineering, and Mathematics, refers to an integrative approach encompassing various disciplines (Kelley & Knowles, 2016). STEM education is considered a process-oriented approach that provides engaging experiences for students by utilizing knowledge and skills from at least two STEM disciplines to address real-life problems (Breiner et al., 2012). One of the primary goals of STEM education is to enhance the number of students choosing STEM-related careers and to encourage the participation of female students in STEM fields (National Research Council [NRC], 2014).

It is crucial to cultivate students' interest in STEM subjects from an early stage to enhance their perceptions of STEM careers (Atkinson & Mayo, 2010; DeJarnette, 2012). Therefore, it is essential for children in early childhood to gain information about professions in STEM fields, as it helps them make informed decisions about their future careers (Luo & So, 2022). Furthermore, it has been found that stereotypes about STEM professions begin at an early age (Capobianco et al., 2011; Luo & So, 2022). For instance, Liben and colleagues (2002) found that young children tend to associate boys with professions, boys with professions such as doctors or engineers, and girls with professions such as librarians or nurses. Similarly, in studies conducted with groups between the ages of 6 and 10, it was found that students perceived scientists and engineers as mostly male (Capobianco et al., 2011; Hansen et al., 2017). In addition to stereotypes about gender, it has been observed that students have misconceptions about the work and working environments of people working in STEM fields. In studies conducted with primary school students, it has been observed that students generally perceive scientists as people who conduct experiments and work in closed areas and engineers as people who do repair work and generally work in construction sites (Fralick et al., 2009). Such perceptions and stereotypes are believed to have adverse effects on children's pursuit of STEM professions in the future (Luo et al., 2021).

The inherent curiosity, creativity, and collaboration exhibited by young children align with the traits essential for STEM education. At the same time, due to these features, early children are naturally interested in STEM-related concepts (Banko et al., 2013). It is believed that the positive experiences of children at this age with STEM may influence their possible STEM-related career

choices in the future. In this context, it is important to examine how STEM professions are portrayed in children's picture books regarding STEM professions (gender, field of study, work done, etc.).

The significance of children's books lies in their ability to help children understand the world and shape their thoughts. These specially crafted books for kids encompass a broad category within children's literature. During early childhood, one of the most crucial aids in achieving this goal is the use of children's picture books. This is because children in this stage are in the pre-operational phase, where they struggle with grasping complex or abstract concepts. Moreover, during this developmental period, children primarily acquire knowledge and explore the world through symbols and language. In this context, children's picture books emerge as potent tools that facilitate children's growth and learning by providing them with experiences involving symbols, visuals, and language use. It is essential that children's picture books are designed with simplicity in both form and content, using language that is easy for children to comprehend, and enhanced with visual elements. By doing so, these books create opportunities for children to learn various concepts, events, and situations more effectively through the medium of books. In light of this information, the following research question was addressed in the current study: "How are STEM professions represented in children's picture books used in early childhood?"

Method

This study aimed to reveal how STEM professions are represented in STEM-related children's picture books. Additionally, the physical properties and illustration features and the content characteristics of the STEM-themed books were also examined. The study employed document analysis, and the study group consisted of STEM-related books available from publishing houses specializing in illustrated children's literature in Turkey. The researchers initially listed picture books from relevant publishing houses and bookstores to form the study group. Books suitable for early childhood were then selected from this list. Then, the keywords "STEM, children's picture books", "STEM, preschool, children's pictures", and "STEM children's picture books and preschool" were used during the search. As a result, ten books on this subject were analyzed within the scope of this research. The study used a book review form created by the researchers, based on

the study conducted by Bilir-Seyhan (2022), as a data collection tool by depending. Descriptive analyses were conducted on the review forms created for each book. In the first step of analysis, the physical and illustration features and the content features of the books were examined. In the second step, the representation of STEM professions in these books was examined. The items such as “which STEM profession is included in the book, the gender of the character in STEM profession, and the working environment of the character” were added to the review form using Checklist for Draw-a-Scientist (DAE) and Draw-an-Engineer (DAE) (Fralick et al., 2009).

Results

Results Regarding the Physical and Illustration Characteristics of Children's Picture Books

In this part of the study, the findings regarding the physical and illustration features of the STEM-themed children's picture books examined are presented through tables.

Table 1

Distribution of Books by Publishing Houses

Publishing House	f	%
Beta Kids	3	30
Tübitak Popular Science Books	2	20
Uçan Fil	2	20
Türkiye İş Bankası Kültür Yayınları	1	10
Martı Çocuk	1	10
İlk Satır Çocuk	1	10
Total	10	100

When the STEM-themed children's picture books included in this study are examined, it can be said that the books are published by different publishing houses. As indicated in Table 1, three were published by Beta Kids, two were published by Tübitak Popular Science Books, two were

published by Uçan Fil, one was published by Türkiye İş Bankası Kültür Yayınları, one was published by Martı Çocuk, and one was published by İlk Satır Çocuk.

Table 2

Distribution of Books According to Publication Years

Publication Years	f	%
2006	1	10
2018	1	10
2019	1	10
2021	1	10
2022	3	30
2023	3	30
Total	10	100

The distribution of children's books examined in the study based on their publication years is presented in Table 2. When the table is examined, it is seen that one of the books was published in 2006, one in 2018, one in 2019, and one in 2021. In addition, it was determined that three different books were published in 2022 and 2023. In this context, it can be said that illustrated children's books dealing with the subject of STEM have been introduced to Turkish literature in recent years. In addition, it was seen that all the books examined were translated books.

Table 3

Distribution of Books by Number of Pages

Number of Pages	f	%
20-30 pages	1	10
31-40 pages	8	80
41-50 pages	1	10
Total	10	100

The distribution of children's books examined in the study based on the number of pages is presented in Table 3. It is seen that the children's book with the least number of pages is 24 pages. It was determined that 80% of the books were between 31-40 pages, five of these books were 32 pages, and three were 40 pages. One of the books is 48 pages.

Table 4

Distribution of According to Recommended Age Groups

Recommended Age Groups	f	%
Not Defined	8	80
3-6 ages	1	10
5+	1	10
Total	10	100

When analyzing the recommended age groups for the books, it was found that eight books did not have any specified age recommendations. It has been determined that only one book was recommended for the age group of 3-6 years old, and another book was suggested for ages five and above. At this point, it can be stated that there is a deficiency in the age point recommended in these reviewed books.

Table 5

Distribution of Books According to Language Characteristics

Language Characteristics	f	%
Simple language	10	100
Grammatical	10	100
Concrete theme	10	100
Punctuation marks	10	100

STEM-themed children's picture books, which constituted the study group of the research, were examined in terms of their language characteristics. It has been observed that the language of all the books is simple and grammatical; a concrete theme is discussed in each book. Additionally, all books are written in accordance with punctuation marks.

Table 6

Distribution of the Books According to Illustration Features

Illustration Features	f	%
Colorful drawings	10	100
Simple	10	100
The picture is not separated from the text by a frame	10	100

STEM-themed children's picture books, which constituted the study group of the research, were also examined in terms of their formal/illustrating features. It has been observed that all of the books examined have colorful drawings and that these drawings have simple features. Additionally, it was determined that the images used in the books were not separated from the text by a frame.

Results Regarding the Content Characteristics of Children's Picture Books

In this part of the study, the findings regarding the content characteristics of the STEM-themed children's picture books examined are presented.

Table 7

Distribution of Reviewed Books According to Content Features

Content Features	f	%
Storybook	10	100
Human story	10	100
It represents real life.	10	100
There is cooperation between the image and the text.	10	100
It has the main idea.	10	100
It is suitable for the age group of children.	10	100
There are introduction, development, and conclusion sections.	10	100
There are additional sections on the subject.	4	40

While examining the books, several content features were taken into consideration. It was seen that all of the books examined were story books and contained human stories. Real life is represented in all of the books. Additionally, it has been determined that there is a collaboration between the picture and the text in all books. It has been observed that all books have a main idea and consist of introduction, development, and conclusion sections. In addition, the books are suitable for the age group of children. On the other hand, only four books contain additional chapters on the subject. These additional sections contain notes to parents, author notes, and informational content.

Results Regarding the Representation of STEM Professions in Children's Picture Books

In this part of the study, the findings regarding the representation of STEM professions in the STEM-themed children's picture books examined are displayed.

Table 8

Descriptive Analysis Regarding Appearance of Characters in STEM-Themed Picture Books

Appearance	f	%
<i>Species</i>		
Human	10	100
Non-human	-	-
No person	-	-
<i>Gender</i>		
Female	8	80
Male	2	20
Unknown	-	-
<i>Skin Color</i>		
Brown	3	30
Peach	6	60
Yellow	1	10
Green	-	-
None	-	-
Other	-	-

Other Attributes

Crazy Hair	2	20
Glasses/ Goggles	1	10
Lab coat	1	10
Laborer's Clothing	-	-
Appearance Other	4	40

The descriptive analysis regarding the physical appearance of characters in STEM-themed picture books is presented in Table 8. It was found that all characters depicted in the books were portrayed as human, with eight of these characters being female and two males. Among the characters, six had peach-colored skin, three had brown skin, and one had yellow skin tones. When examining other characteristics of the characters regarding STEM professions, it was observed that in two books, a character with wild hair was present; in one book, a character wore glasses/protective eyewear; and in one book, a character was depicted wearing a laboratory outfit. Additionally, in four books, characters were noted to use other accessories such as gloves, a princess crown, and a space suit.

Table 9

Descriptive Analysis Regarding Characters' Action in STEM-Themed Picture Books

Inferences of Action	f	%
Making/Fixing/Working with Hands	3	30
Operating/Driving Machines & Vehicles	1	10
Designing/Inventing/Creating Products	6	60

Experimenting/Testing/Creating Knowledge	3	30
Explaining / Teaching	-	-
Observing	1	10
No Action Inferred	-	-

The descriptive analysis regarding characters' inferred actions in STEM-themed children's picture books are presented in Table 9. It was observed that in six books, the character engaged in product design/invention/production, in three books, the character engaged in hands-on work/repair/construction activities, in three books, the character engaged in knowledge generation/testing/experimentation, in one book the character used a machine/tool, and in one book, the character was depicted engaging in observational activities.

Table 10

Descriptive Analysis Regarding Characters' Working Location in STEM-Themed Picture Books

Location	f	%
Indoors	5	50
Outdoors	2	20
Space	2	20
Underground	-	-
Underwater	-	-
Can't Tell	3	30

The results of the descriptive analyses of the STEM-themed picture books regarding the characters' working locations are presented in Table 10. It was determined that in five books, the characters worked indoors, two characters worked outdoors, and two characters worked in space. Additionally, in three books, it was not clear where the characters were working.

Table 11

Descriptive Analysis of Objects Used by Characters in STEM-Themed Picture Books

Objects	f	%	Objects	f	%
Other people	2	20	Other Machines	-	-
Non-Humans - monsters, etc.	-	-	Books	5	50
Body Parts – parts in jars, brains, etc.	-	-	Furniture – tables, chairs, etc.	1	10
Robots	-	-	Math Symbols	1	10
Computer	1	10	Chemical Symbols	1	10
Building Tools – wrench, hammer, etc.	6	60	Blueprints, Drawings and Graphs	5	50
Measuring Tools – rulers, etc.	3	30	Diplomas / Awards	1	10
Writing Objects – papers, pens, etc.	7	70	Weapons – guns, bombs, etc.	-	-
Studied Animals	1	10	Keep Out / Beware Signs	-	-
Other Animals	6	60	Danger – fire, explosions, etc.	-	-
Studied Plants	2	20	Civil Structures – bridges, buildings, etc.	-	-

Other Plants	-	-	Chemistry - flasks, test tubes, etc.	2	20
Rocks	-	-	Technology - TVs, radios, phones, etc.	-	-
Passenger Vehicles	1	10	Medicine - germs, syringes, needles, etc.	-	-
Construction Vehicles	-	-	Meteorology	-	-
Flying Vehicles	-	-	Sports	-	-
Rockets / Space Vehicles	2	20	Signs of Thinking	1	10
Fictional Machines	4	40	Other	3	30

The descriptive analysis regarding objects used by the characters in STEM-themed picture books are presented in Table 11. A wide variety of objects are visualized and used in the examined books, including: writing tools ($n=7$), construction tools ($n=6$), other animals ($n=6$), books ($n=5$), imaginary/fictional machines ($n=4$), measuring tools ($n=3$), experimental plants ($n=2$), other people ($n=2$), rockets/spacecraft ($n=2$), chemistry equipment, test tubes, beakers, etc. ($n=2$), templates, drawings, graphics ($n=1$), computer ($n=1$), lab animals ($n=1$), passenger vehicles ($n=1$), furniture - table, chair, etc. ($n=1$), mathematical symbols ($n=1$), chemical symbols ($n=1$), diplomas, awards ($n=1$), symbols related to thinking ($n=1$), and others ($n=4$). Among the objects defined as "others," there are microscopes, a solar system model, a DNA model, and a lunar vehicle. Additionally, among the imaginary/fictional machines, objects such as "cheesecopter" and "spaghetti whirligig" were encountered.

Discussion

The representation of STEM professions in children's picture books has the potential to offer positive role models to children. The characters practicing STEM professions in these books demonstrate potential success by presenting success stories and inspiring examples to children. According to analyses, it is evident that different STEM professions are included in the reviewed books. For instance, while the story of an astronaut is told in the book *On the Moon*, the story of a

girl who makes designs is told in the book *The Most Magnificent Thing*. Akıncı-Coşgun and Yılmaz (2022) examined 21 STEM-content illustrated children's books in Turkish by considering the gender variable and found that most of the characters in the books were male. On the other hand, Cardullo and Burton (2022), in their study investigating diversity (gender, ethnicity, socioeconomic status, etc.) in illustrated STEM books for primary school age, concluded that the main characters in most of the 25 books examined were women. In the books analyzed in this study, the main character on the cover of the book *On the Moon* is depicted as a male, while the cover of the book *The Most Magnificent Thing* is a girl. This diversity in books can help children develop sensitivity to gender discrimination and understand that both genders can pursue STEM professions. Additionally, it is considered crucial to incorporate STEM professions in STEM-related children's picture books, as they can provide inspiration and motivation to children.

As a result of the research, it was determined that the children's books examined were published by various publishing houses. When analyzing the publication years of these children's books, the prevalence of recent publications suggests that publishing houses are attuned to current trends and topics in children's literature. Furthermore, it can be said that publishing houses prefer up-to-date translation books to expand the range of topics, characters, and illustrations in children's books.

The presence of recommended age group information in children's picture books has the power to guide families and teachers when choosing books. In the study, when the recommended age groups in the books were examined, it was seen that the recommended age group was not specified in 8 of the books. Similar findings were observed in the study conducted by Gönen et al. (2012), and it was stated that approximately 60% of the books did not contain age group expression. It was emphasized that this absence could be perceived as a drawback. Identifying the target age group for children's books is a crucial criterion for families when selecting appropriate reading material for their children (Kıldan & Gümrükçü Bilgici, 2011). For this reason, it can be said that this feature should be given more importance in children's books so that adults who interact with children can be supported in choosing books suitable for children's developmental characteristics.

Conclusion

In conclusion, it was found that STEM professions were represented from different perspectives in the books examined. It is thought that such books are helpful for children to develop a positive

perspective towards STEM professions in early childhood. They offer children valuable insights and examples of STEM professions, enriching their understanding. Consequently, books serve as effective tools for children to understand certain concepts more easily in early childhood.

Recommendations

Based on the findings of this study, it is recommended to increase the number of high-quality books representing STEM professions, use these books in early childhood education, increase educators' awareness, and conduct awareness studies for families. Since all the books examined are translation books, it is recommended to write Turkish books on this subject.

References

- Akıncı-Coşgun, A., & Yılmaz, T. P. (2022). STEM içerikli resimli çocuk kitaplarında toplumsal cinsiyet rollerinin sunumu. *Ihlara Eğitim Araştırmaları Dergisi*, 7(2), 139-148.
- Atkinson, R. D., & Mayo, M. J. (2010). Refueling the US innovation economy: Fresh approaches to science, technology, engineering, and mathematics (STEM) education. *The Information Technology & Innovation Foundation*, 1-2.
- Banko, W., Grant, M. L., Jabot, M. E., McCormack, A. J., & O'Brien, T. (2013). *Science for the next generation: Preparing for the new standards*. National Science Teachers Association (NSTA) Press.
- Bilir-Seyhan, G. (2022). *Analyzing effects of picture story book reading activities on 3-years-old children's language development and social skills* [Unpublished doctoral dissertation]. Hacettepe University.
- Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. *School Science and Mathematics*, 112(1), 3-11.
- Cardullo, V., & Burton, M. (2022). Picture books in the primary grades: Representation and the stories shared about who belongs in STEM. *Early Childhood Education Journal*, 1-14.
- Capobianco, B. M., Diefes-Dux, H. A., Mena, I., & Weller, J. (2011). What is an engineer? Implications of elementary school student conceptions for engineering education. *Journal of Engineering Education*, 100(2), 304-328.

- DeJarnette, N. (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. *Education*, 133(1), 77-84.
- Fralick, B., Kearn, J., Thompson, S., & Lyons, J. (2009). How middle schoolers draw engineers and scientists. *Journal of Science Education and Technology*, 18, 60-73.
- Gönen, M., Uygun, M., Erdoğan, Ö., & Katrancı, M. (2012). Resimli çocuk kitaplarının fiziksel, içerik ve resimleme özellikleri açısından incelenmesi. *Milli Eğitim*, 196, 258-272.
- National Research Council [NRC]. (2014). STEM integration in K-12 education: Status, prospects, and an agenda for research. The National Academies Press. <https://nap.nationalacademies.org/catalog/18612/stem-integration-in-k-12-education-status-prospects-and-an>
- Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM education*, 3(1), 1-11.
- Kıldan, A. O., & Gümrükçü Bilgici, B. (2011). Okul öncesi eğitim alan çocukların ebeveynlerinin çocuk kitabı seçme ölçütlerine ilişkin görüşlerinin belirlenmesi. *Milli Eğitim*, 192, 105-120.
- Liben, L. S., Bigler, R. S., & Krogh, H. R. (2002). Language at work: Children's gendered interpretations of occupational titles. *Child Development*, 73, 810-828.
- Luo, T., & So, W. W. M. (2022). Elementary students' perceptions of STEM professionals. *International Journal of Technology and Design Education*, 1-20.
- Luo, T., So, W. W. M., Wan, Z. H., & Li, W. C. (2021). STEM stereotypes predict students' STEM career interest via self-efficacy and outcome expectations. *International Journal of STEM Education*, 8(1), 1-13.